POLICY ISSUE
(Notation Vote)

April 20, 2009 SECY-09-0064

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: REGULATION OF FUSION-BASED POWER GENERATION DEVICES

PURPOSE:

To obtain Commission approval of the U.S. Nuclear Regulatory Commission (NRC) staff's recommended approach to evaluate policy and technical issues and develop a recommendation for Commission consideration regarding the possible regulation of fusion-based commercial power generation devices that would operate within the United States.

SUMMARY:

Recent activities associated with the development of fusion energy devices have raised questions about the possible need to regulate fusion energy and specifically the role of the NRC. The Commission has, to date, not exercised regulatory jurisdiction over fusion devices. The Commission has not developed regulations or actively participated in the licensing and/or oversight of construction or operation of existing fusion research facilities. In addition, the NRC has not regulated exports of fusion reactors and equipment specially designed for use in fusion devices. This paper defines several options for consideration by the Commission. The NRC staff recommends Option 2, which involves: (1) the Commission, as a general matter, asserting regulatory jurisdiction over commercial fusion energy devices, and (2) the NRC staff conducting further evaluations of the technical and legal issues associated with the regulation of specific fusion devices and providing more detailed recommendations to the Commission in a future paper.

CONTACTS: William D. Reckley, NRO/ARP
(301) 415-7490

Stephen Dembek, IP/ECIOB
(301) 415-2342

BACKGROUND:

To date, the NRC has not participated in the development or licensing of fusion energy facilities. Within the United States, the U.S. Department of Energy (DOE) funds operating fusion research facilities related to magnetic confinement, including the DIII-D facility operated by General Atomics in San Diego, California, the National Spherical Torus Experiment operated at Princeton University, and the Alcator C-Mod facility at the Massachusetts Institute of Technology. Additional research coordinated and funded by DOE includes inertial confinement and other research facilities at selected universities and laboratories. A significant part of the current U.S. fusion program, which is coordinated primarily by DOE, involves membership in the international magnetic fusion project known as ITER. Several privately funded research and development efforts are also underway that are not directly related to the fusion programs funded and coordinated by DOE. [

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The staff has responded to inquiries (mainly informal) from potential fusion reactor component exporters as to whether an NRC license is required for such exports. Because significant research and development work on ITER and other fusion programs is currently in progress and exports in support of ITER have begun, the staff thought it was appropriate to inform the Commission that, at this time, the staff is continuing its current practice of not regulating exports of equipment specially designed for use in fusion research devices. Currently, exports of equipment specially designed for use in fusion reactors are under the jurisdiction of the U.S. Department of Commerce. The representatives attending an interagency meeting regarding ITER held at the U.S. Department of State on July 1, 2008, did not raise concerns with continuing the Commerce Department's jurisdiction over exports of fusion devices and related equipment.

DISCUSSION:

Several private initiatives are underway that are largely outside the fusion energy research activities coordinated by DOE's Fusion Energy Science Program. These programs, as well as publicity surrounding the ITER facility and a general level of increased discussion about energy research and development, have raised questions about the regulation of fusion devices and specifically the role of the NRC. The Commission has not exercised regulatory jurisdiction over fusion devices by developing regulations or actively participating in the licensing and/or oversight of construction or operation of existing fusion research facilities. NRC regulations, including the definitions of "utilization facility" and "special nuclear material," do not currently address fusion energy devices or otherwise bring these devices under NRC jurisdiction. The Commission has not exercised regulatory jurisdiction over machines such as particle accelerators and, until the passage of Section 651(e) of the 2005 Energy Policy Act (EPAct), did not assert regulatory jurisdiction over accelerator-produced materials. However, several studies sponsored by private firms and DOE as part of the fusion program have presented information about NRC's possible regulation of commercial fusion facilities.

The Commission may be able to exercise regulatory jurisdiction over fusion devices (or certain types of fusion devices) by treating such devices as "utilization facilities" and licensing and regulating them under the applicable provisions of the Atomic Energy Act (AEA) of 1954, as amended. Section 11 of the AEA defines "utilization facility" as including "any equipment or device...determined by rule of the Commission to be capable of making use of...atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public." Thus, to be able to regulate a fusion device as a utilization facility, the Commission must find in a rulemaking both that: (1) fusion constitutes "atomic energy" within the meaning of the AEA, and (2) the fusion process is of such quantity as to be "of significance to the common defense and security, or in such manner as to affect the health and safety of the public."

With respect to whether fusion constitutes "atomic energy," there is some evidence that Congress intended the AEA to provide the Atomic Energy Commission with regulatory and licensing authority over fusion processes as well as fission processes. A report of the Joint Committee on Atomic Energy regarding the 1954 AEA amendments included statements that the Commission was empowered to regulate materials that can be used in fusion processes. Specifically, the Joint Committee stated the following (see Chapter 2, "Definitions" (page 11), of Senate Report No. 1699, "Amending the Atomic Energy Act of 1946, as amended, and for Other Purposes"):

> "Atomic energy" is defined to mean "all forms of energy released in the course of nuclear fission or nuclear transformation." This definition includes both fission and fusion types of nuclear reactions. It has been clarified to mean only that energy released "in the course of" nuclear fission or nuclear transformation. The definition in the act also includes energy released "as a result of" such fission or transformation, and is scientifically broader than is necessary or desirable. Its deletion in the bill will not change the intended scope of the act or jurisdiction of the Atomic Energy Commission.

The Committee further stated the following on page 8 of the same report:

> The phrase "fissionable material" is stricken from the proposed legislation, and the new words "special nuclear material" are substituted in its stead. This change is intended to clarify the original provision of the act to give to the Commission, in addition to the power to determine and regulate the use of materials utilizable in the fission process, the power to perform the same function in respect to materials which can be utilized in fusion processes.

The inclusion of fusion reactions within the scope of "atomic energy" is also consistent with today's common-use definition of the term "nuclear energy," which includes both energy from fission and energy from fusion.

The second part of the definition involves whether the fusion process is of "such quantity as to be of significance to the common defense and security," or the device uses fusion "in such manner as to affect the health and safety of the public." Fusion energy devices will generate some level of radiation from nuclear reactions, bremsstrahlung[1], and resultant radioactive materials. The NRC staff believes that additional evaluations are needed to assess whether specific fusion energy devices would warrant NRC licensing and regulation to protect workers and the general public. An additional consideration involves the potential benefits of the NRC establishing a national regulatory framework for fusion devices instead of requiring various State and local agencies to develop programs to address this new technology.

The NRC staff is also evaluating the feasibility of indirectly regulating and licensing a research-oriented fusion device by extending the NRC's current materials licensing paradigm. Under that paradigm, the NRC licenses the use or production of radioactive material, but it establishes minimal regulatory requirements over the design and construction of the device or apparatus using the licensed material (*e.g.*, an accelerator or irradiator). The EPAct established the NRC's regulatory jurisdiction over specified accelerator-produced materials. Section 651(e) of the EPAct amends the definition of "byproduct material" in Section 11 of the AEA by adding, inter alia, a new paragraph (3)(B). Under this new paragraph, byproduct material is now defined to include the following:

> (B) any material that—
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> (i) has been made radioactive by use of a particle accelerator; and
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> (ii) is produced, extracted, or converted after extraction, before, on, or after the date of enactment of this paragraph for use for a commercial, medical, or research activity....

The NRC staff determined that additional evaluations are needed to assess whether specific fusion energy devices could be reasonably categorized as accelerators and if the resultant radioactive materials are produced for a commercial, medical, or research activity.

If the Commission were to assert jurisdiction over fusion devices, either regulatory approach (i.e., the licensing as a utilization facility or the indirect regulation of "byproduct material") would require significant evaluation and adaptation of existing laws, regulations, and guidance. In deciding whether to assert jurisdiction over the regulation of fusion devices and in possibly developing a regulatory framework for such devices, the NRC must be cognizant of current circumstances and arrangements. For example, various research facilities are currently operating within the United States without NRC licensing or regulation. In addition, the NRC

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[1] Bremsstrahlung is the electromagnetic radiation given off by a high-energy particle, such as an electron, when suddenly accelerated or decelerated by an electric field or by another charged particle, such as an atomic nucleus.

has been party to interagency discussions regarding the ITER that have established the Department of Commerce as having jurisdiction over exports of technology and materials supporting that program. The NRC's export regulations rely on the existing definitions of "utilization facility" and "special nuclear material" within the NRC's regulations, which do not cover fusion devices.

If the Commission decides to assert jurisdiction over fusion devices, it would be possible to develop short- and long-range plans to address specific situations while also maintaining consistency with current practices for the broader fusion research program. Additional technical and legal evaluations are required to develop possible options for both short- and long-range planning. For example, many questions concern the potential radiological hazards associated with different fusion designs and the protective measures, if any, that would be needed in the design and operation of such facilities. There are also questions regarding the regulatory actions that would be required for the NRC to assert jurisdiction over fusion devices.

A Commission decision to regulate fusion energy devices would represent a new programmatic effort not previously identified in agency budget requests to the Congress. Pursuant to our agreement with the House Appropriations Committee and past agency practice, the usual procedures for reprogramming of funds should be followed.

Options

Option 1—Status quo (i.e., continue to monitor progress and coordinate activities with other Federal agencies)

Since there is a high degree of uncertainty as to if or when fusion energy technology will be commercialized (i.e., when it would be used by the civilian market that the NRC typically regulates), the Commission could find that no near-term public health and safety or common defense and security concerns justify NRC regulation of fusion devices at this time. Under Option 1, the NRC would continue to monitor progress in the development of fusion reactor technology and defer the resolution of jurisdiction issues until its commercial deployment is more predictable (e.g., following successful testing of a fusion technology). The staff could initiate limited interactions with other Federal agencies and establish a long-term goal of reaching consensus on the regulation of fusion energy devices.

For example, the NRC could coordinate activities for the regulation of fusion energy using a framework similar to the one established for consulting with other Federal agencies on discrete sources of naturally occurring radioactive materials. The language of the EPAct, which was subsequently incorporated into the NRC regulations defining "byproduct material," states the following:

(4) Any discrete source of naturally occurring radioactive material, other than source material, that—

(i) The Commission, in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, the Secretary of Homeland Security, and the head of any other appropriate Federal agency, determines would pose a threat similar to the threat posed by a discrete source of radium-226 to the public health and safety or the common defense and security;

The staff could also prepare a draft Commission policy statement for consideration and subsequent solicitation of public comments on the NRC's regulation of fusion energy devices. The NRC could include such activities in future budget cycles (e.g., FY 2011 or beyond). Under this option, Government-sponsored research facilities would continue to use DOE-generated safety guidance. Private-sector research facilities could be regulated in accordance with requirements established by State or local governments for accelerators or similar devices.

An advantage of Option 1 is that the NRC would not expend resources to develop policies and a possible regulatory framework for a technology that may not be viable in the foreseeable future. The disadvantages of deferring decisions include the possible development of divergent regulatory approaches for fusion energy devices by different Federal agencies and individual State and local governments.

Option 2—Commission asserts jurisdiction and NRC staff undertakes further evaluations

Under this option, the Commission would determine, as a general matter, that the NRC has regulatory jurisdiction over commercial fusion energy devices whenever such devices are of significance to the common defense and security, or could affect the health and safety of the public. The staff would conduct further evaluations of the technical and legal issues associated with the regulation of specific fusion devices by using information available in the scientific literature [ ] The Office of New Reactors would continue coordinating with other NRC offices the evaluation of technical and legal issues related to the regulation of fusion devices and the preparation of more detailed recommendations, including organizational roles and responsibilities, to be provided to the Commission in a future paper. The paper would address both possible short-term situations and longer-term development of regulations and other infrastructure for the licensing and oversight of all or some fusion energy devices. These activities would likely span several years and, if conducted prior to inclusion in a future NRC budget request, would require submission of a request to reprogram funds to the House and Senate Appropriations Committees. Pending the completion of any related rulemakings, Government-sponsored research facilities would continue to use DOE-generated safety guidance. Private-sector research facilities would either be regulated in accordance with State and local regulations or, if possible and warranted, would be brought under the NRC's licensing and regulatory programs through a specific regulatory action (i.e., a rulemaking or order).

Option 2 would provide the benefit of the Commission resolving the fundamental question of regulatory jurisdiction while also having the NRC staff develop plans and approaches for possible short- and long-term scenarios. A possible disadvantage of Option 2 is that such a decision now may commit the NRC at some point in the future to expend significant resources to develop a regulatory framework for fusion energy.

Option 3—Commission defers decision pending further evaluations by NRC staff

Under this option, the Commission determines that a decision on regulatory jurisdiction for fusion energy is needed but defers the actual decision pending completion of NRC staff evaluations of the technical and legal issues associated with the regulation of specific fusion devices. [

] This information would form part of the basis for specific recommendations under Option 2 and could also support this option and allow the Commission to have available more information to support its deliberations. As described under Option 2, pending Commission action, Government-sponsored research facilities would continue to use DOE-generated safety guidance. Private-sector research facilities would either be regulated in accordance with State and local regulations or, if directed by the Commission, would be brought under the NRC's licensing and regulatory programs through a specific regulatory action (i.e., a rulemaking or order).

An advantage of Option 3 is that the decision-making processes would be supported by more information from DOE and other stakeholders regarding the designs and potential hazards from proposed fusion devices. A disadvantage of this option is that while not deferring decisions indefinitely, it would postpone a Commission decision on regulatory jurisdiction of fusion energy pending inclusion of this activity in the NRC's budget or a request to reprogram funds and subsequent completion of the NRC staff's evaluation. This delay would likely be on the order of two or three years.

Option 4—Commission decides that the NRC will not assert jurisdiction

Under this option, the Commission would determine that the NRC will not exercise regulatory jurisdiction over commercial fusion energy devices unless instructed to do so by legislation or other authority. If the Commission chose Option 4, the NRC staff would not conduct further evaluations [

] Government-sponsored research facilities would continue to use DOE-generated safety guidance. Private-sector research facilities could be regulated in accordance with requirements established by State or local governments for accelerators or similar devices.

Option 4 would, unless the agency was directed otherwise by legislation or other authority, resolve the immediate question of NRC's regulatory jurisdiction over fusion energy. The disadvantages of this option include the possible development of divergent regulatory approaches for fusion energy devices by different Federal agencies and individual State and local governments.

RECOMMENDATION:

The staff recommends Option 2, which involves: (1) the Commission, as a general matter, asserting regulatory jurisdiction over commercial fusion energy devices, and (2) the NRC staff conducting further evaluations of the technical and legal issues associated with the regulation of specific fusion devices and providing more detailed recommendations to the Commission in a future paper.

RESOURCES:

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] The staff would request resources for FY 2011 and beyond through the Planning, Budget, and Performance Management process.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection. The Office of the Chief Financial Officer has reviewed this paper for resource implications and has no objections.

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/RA Bruce Mallett for/

R. W. Borchardt
Executive Director
for Operations